PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Masayuki MISHIMA

Docket No: Q64324

Appln. No.: 09/845,356

Group Art Unit: 1774

Confirmation No.: 2603

Examiner: Marie Rose Yamnitsky

Filed: May 1, 2001

For: LIGHT-EMITTING DEVICE

DECLARATION UNDER 37 C.F.R. § 1.132

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Masayuki Mishima, hereby declare and state:

THAT I am a citizen of Japan;

THAT I graduated from the Graduate School of Engineering, Kyoto University, in March, 1982;

THAT I became employed by Kao Corporation in April, 1982;

THAT I have been employed by Fuji Photo Film Co., Ltd., now FUJIFILM Corporation, since July, 1991;

THAT I am the inventor of the invention described and claimed in the above-identified application, and am familiar with the Office Action of September 10, 2007, and the rejection contained therein.

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In order to demonstrate the unexpected superiority of the present invention, the following experimentation was conducted by me or under my direct supervision.

Light-emitting devices (1) and (2) were prepared having the features as stated below according to Additional Comparative Examples 1 and 2, respectively, and otherwise having the features of the device according to Example 1 in the specification. The devices were evaluated in accordance with the explanation set forth in connection with Example 1. The results are shown in Table 2 below.

(1) Additional Comparative Example 1:

Polyvinyl carbazole / tris(2-phenylpyridine)iridium complex (an orthometallated complex as a green light-emitting material) / 2-(4-biphenyl)-5-(4-t-butylphenyl)-1,3,4-oxadiazole (electron transporting material) = 200 / 6 / 50 (by weight);

(2) Additional Comparative Example 2:

Polyvinyl carbazole / coumarin 6 (a green light-emitting material) / 2-(4-biphenyl)-5-(4-t-butylphenyl)-1,3,4-oxadiazole (electron transporting material) = 200 / 6 / 50 (by weight).

[Table 2]

	Lmax (Cd/m^2)	Vmax (V)	P (Cd/A)	Light-emitting wavelength peak (nm)
Additional Comparative Example 1	32000	11	25	515
Additional Comparative Example 2	28000	15	1.8	520

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Both of the devices (1) and (2) according to Additional Comparative Examples 1 and 2 contained only a green light-emitting material as their light-emitting material. In other words, the devices were compared in performance by the green light-emitting materials which they contain. While the device (2) containing coumarin 6 as its green light-emitting material showed a maximum luminance Lmax of 23,000, the device (1) containing an orthometallated complex as its green light-emitting material showed a maximum luminance Lmax of 32,000, which is higher than that of the device (2), but only about 1.4 times higher.

According to the Examples in the specification, the devices of Examples 1 to 4 each containing a blue, a green and a red light-emitting material in its light-emitting layer and employing an orthometallated complex as its green light-emitting material were evaluated with the devices of Comparative Examples 1 and 2 each containing a blue, a green and a red light-emitting material in its light-emitting layer and employing coumarin 6 as its green light-emitting material. Accordingly, the devices containing a blue and a red light-emitting material as well as a green light-emitting material were compared. While the device of Comparative Example 1 employing coumarin 6 as its green light-emitting material showed a maximum luminance Lmax of only 2,400, the device of Example 1 employing an orthometallated complex as its green light-emitting material showed a maximum luminance Lmax of 23,000, which is as much as about 10 times higher than that of the device of Comparative Example 1. Each of the devices according to Examples 1 and 2 and Comparative Example 1 contained a mixture of green, blue and red light-emitting material in a single layer, while each of the devices according to Examples 3 and 4 and Comparative Example 2 contained green, blue and red light-emitting material in different layers,

respectively. While the device of Comparative Example 2 employing coumarin 6 as its green light-emitting material showed a maximum luminance Lmax of only 5,200, the device of Example 3 employing an orthometallated complex as its green light-emitting material showed a maximum luminance Lmax of 56,000, which is as much as about 10 times higher than that of the device of Comparative Example 2.

Thus, the device containing an orthometallated complex as its green light-emitting material, as well as containing a blue and a red light-emitting material, exhibited a drastically improved luminance owing to the orthometallated complex. As a consequence, it provided a white light-emitting device realizing an excellent maximum luminance.

The outstanding advantages of the device as claimed presumably owe themselves to a mechanism which will now be stated.

<Presumed Mechanism>

When an orthometallated complex is used as a green light-emitting material, its relatively long exciton lifetime (~ μsec) causes the transfer of energy from the exciton of the green light-emitting material to the red light-emitting material to occur and enables the red light-emitting material to emit light efficiently. However, when the green light-emitting material is not an orthometallated complex, it has a relatively short exciton lifetime (~ nsec), and even if the green and red light-emitting materials may be contained in a single layer, or in separate, but adjacent layers, it is difficult to obtain the transfer of energy from the exciton of the green light-emitting material to the red light-emitting material and utilize the intense emission of the green light-emitting material satisfactorily for the emission of a red light.

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The invention as claimed is essentially featured by employing an orthometallated complex as a green light-emitting material to cause the transfer of energy to the red light-emitting material and raise the efficiency of emission of a red light to thereby realize the emission of an excellent white light of high luminance, as explained above.

It would not have been possible for one of ordinary skill in the art to expect the outstanding results of the present invention as stated above from a light-emitting layer containing a blue, a green and a red light-emitting material and an orthometallated complex as the green light-emitting material when the present application was filed.

Thus, I conclude that the present invention provides unexpectedly superior results and is not obvious accordingly.

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: 10/26/2007

By: Masayuki Mishima
Masayuki Mishima